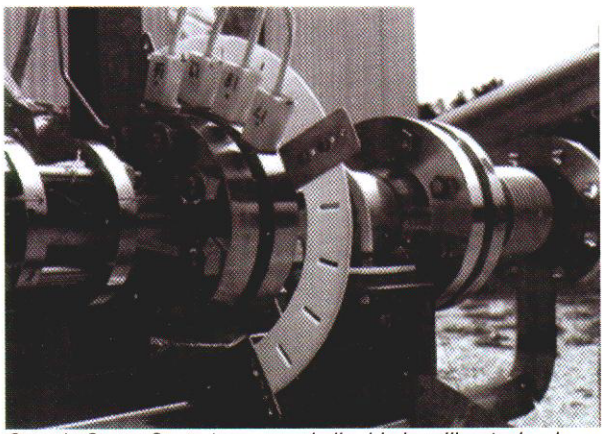
Hydrogen Sensor

New Hydrogen Sensor Is Small, Rugged, And Inexpensive

A new-generation hydrogen sensor that is smaller, faster, sturdier, and less expensive to manufacture has been developed at Sandia National Laboratories. Early versions of this practical, reliable device for detecting hydrogen already have completed the design, fabrication, and test stages and are now in field application.

Existing techniques for detecting hydrogen have numerous drawbacks: limited dynamic range; poor reproducibility and reversibility; subject to false alarms; and tend to be slow, unreliable, and difficult to use.

Figure 1: Multi-point hydrogen leak detection system for the NASA



Stennis Space Center's cryogenic liquids handling technology

In comparison, the Sandia sensor provides:

- Hydrogen detection over a broader range of concentrations (.0001% to 100%).
- Smaller size to allow monitoring at various points (.0004 liter size, 1 gram weight).
- Reliable performance over a greater temperature range (100°C to 140°C).
- Dependable operation in diverse environments (vacuum, non-oxygen ambient, hostile vibration/radiation conditions).

The sensor also exhibits outstanding reproducibility and reversibility, and good long term stability. It is manufacturable with standard microelectronics technology, and the sensor is simple to use.

A broad list of potential applications has been identified, such as:

- Sensing hydrogen buildups in lead acid storage cells found in most vehicles and other applications.
- Detecting hydrogen leaks during ammonia, methanol manufacturing, and desulfurization of petroleum products along with many other petrochemical applications where high pressure hydrogen is used.
- Detecting impending transformer failure in electric power plants.
- Monitoring hydrogen buildup in radioactive waste tanks and in plutonium reprocessing.
- Detecting hydrogen leaks during space shuttle launches and other National Aeronautics and Space Administration (NASA) operations.
- Other molecules besides hydrogen have been detected and arrays of sensors with different catalytic metals can be used to distinguish different molecules.

The sensors are presently being used in a multi-point hydrogen leak detection system at NASA's Stennis Space Center (see Figure 1). Work is underway to use the devices in a number of additional NASA ground-based and flight systems. The sensors also have been used in two field applications -- one in support of environmental monitoring

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at one of Hanford's waste sites and another involving nuclear reactor safety.

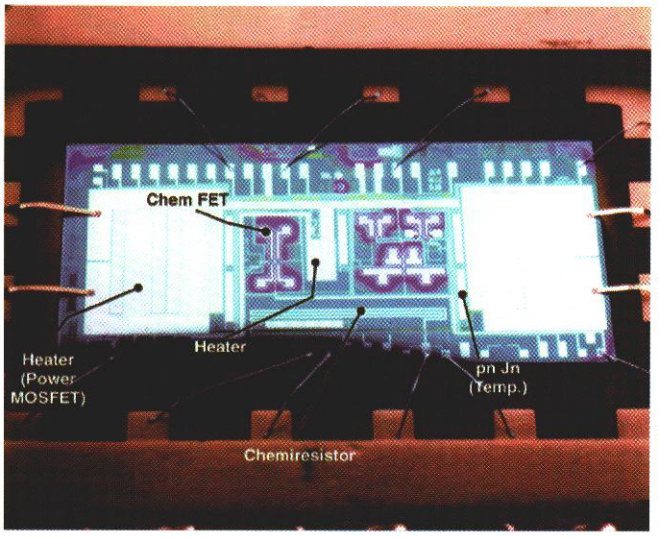


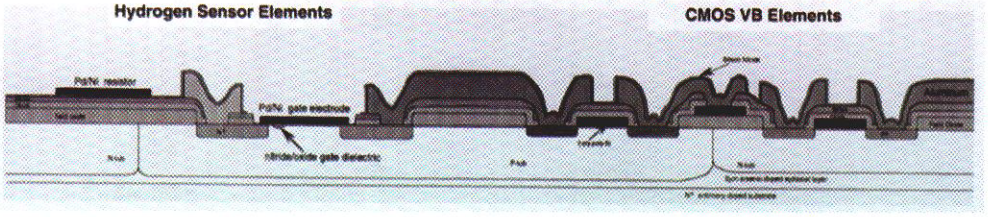
Figure 2: Sandia's Robust, Wide-Range Hydrogen Sensor overcomes the limitations of existing hydrogen sensing technologies.

Technical Approach

This new technology -- known as the Robust, Wide-Range Hydrogen Sensor (shown in Figures 2 and 3) – was created by integrating special catalytic alloy films into Sandia's existing complementary metal oxide semiconductor (CMOS) microelectronic technology. The hydrogen sensor uses catalytic palladium nickel (PdNi) gate metallization on field effect transistor sensors for detecting low concentrations of hydrogen (part per million); PdNi resistor sensors for detecting higher concentrations of hydrogen (up to 100%); and on-chip micro-thermometers and micro-heaters for maintaining constant chip temperature (see cross section in Figure 3). Custom control, communication, and other special function electronics can be fabricated on the same small piece of silicon containing the sensor elements. The unique PdNi catalytic alloy used in this project has been patented.

This technology has been exclusively licensed by DCH Technology, Inc. of Valencia, CA, Phone: (805) 775-8120. DCH is interested in OEM and other partnering arrangements for specific applications of the hydrogen sensor.

Figure 3: Cross section of Sandia's Robust, Wide-Range Hydrogen Sensor. Integration of sensing alloys with the CMOS technology



allows fabrication of control electronics on-chip with the sensor elements.

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